3. Source Assessment

This section identifies and examines the potential sources of aluminum, iron, manganese, selenium, fecal coliform bacteria, and pH in the Guyandotte River watershed. A wide range of data were used to identify potential sources and to characterize the relationship between point and nonpoint source discharges and in-stream response at monitoring stations.

3.1 Data Inventory and Review

Data collection was a cooperative effort involving various governmental groups and agencies in West Virginia, while U.S. EPA Region 3 provided support and guidance for TMDL analysis and development. The categories of data used in developing these TMDLs include physiographic data, which describe the physical conditions of the watershed; environmental monitoring data, which identify potential pollutant sources and their contribution; and in-stream water quality monitoring data. Additional water quality monitoring data gathered by non-governmental groups were obtained through the West Virginia Department of Environmental Protection (WVDEP). Table 3-1 shows the various data types and data sources used in these TMDLs.

Table 3-1. Inventory of data and information used to develop the Guyandotte River watershed TMDLs

Data Category	Description	Data Source(s)
Watershed physiographic data	Landuse	WV Gap Analysis Project (GAP)
	Abandoned mining coverage	WVDEP, Division of Mining and Reclamation (DMR)
	Active and historical mining information	WVDEP, DMR
	Soil data (STATSGO)	U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS)
	Stream reach coverage	USGS; WVDEP, Division of Water and Waste Management (DWMM)
	Weather information	National Climatic Data Center
	Oil and gas operations coverage	WVDEP, Office of Oil and Gas (OOG)
	Paved and unpaved roads	WV Department of Transportation (DOT), USDOT
	Timber harvest data	USDA, U.S. Forest Service (USFS)
Environmental monitoring data	National Pollutant Discharge Elimination System (NPDES) data	WVDEP, DMR; WVDEP, DWMM
	Discharge Monitoring Report data	WVDEP, DMR, Mining Companies
	Abandoned mine land data	WVDEP, DMR; WVDEP, DWMM
	303(d) listed waters	WVDEP, DWMM
	Water quality monitoring data for 496 sampling stations	EPA STORET; WVDEP, DWMM

3.2 Stream Flow Data

There are 24 U.S. Geological Survey (USGS) flow gauges in the Guyandotte River watershed. Flow data from these USGS gauges were used to support flow analysis for the watershed. Table 3-2 shows the 24 flow gauging stations with available records of flow data and the corresponding period of record for each. These stations were used to characterize the stream flow in the watershed.

Table 3-2. Flow analysis for the Guyandotte River watershed

Station	Stream Name	Start Date	End Date	Minimum (cfs)	Average (cfs)	Maximum (cfs)
03204220	Mud River at Mud, WV	11/1999	12/1999	2.1	16.1	135.0
03203950	Guyandotte River at Midkiff, Wv (aux gauge) Ninemile Creek near Brownsville	3/1979	5/1979	1,260.0	1,847.4	3,350.0
03203700	Island Creek at Logan, Wv	10/1976	10/1977	0.0	214.7	1,520.0
03204205	Unnamed tributary to Ballard Fork near Mud, WV	11/1999	8/2000	0.7	0.2	1.8
03204215	Ballard Fork near Mud, WV	11/1999	8/2000	0.1	2.0	29.0
03204210	Spring Branch near Mud, WV	11/1999	8/2000	0.0	0.4	14.0
03202310	Bearhole Fork at Pineville, WV	11/1997	12/1979	0.1	11.0	278.0
03202695	Milam Fork at Mcgraws, WV	11/1997	12/1979	0.0	14.5	375.0
03202240	Allen Creek at Allen Junction, WV	11/1997	12/1979	0.4	11.8	318.0
03202255	Still Run at Itmann, WV	11/1997	12/1979	0.1	12.2	376.0
03202260	Black Fork above Black Fork Falls near Mullens, WV	12/1980	1/1983	0.0	3.2	81.0
03202262	Black Fork at mouth near Mullens, WV	12/1980	1/1983	0.1	3.7	84.0
03202245	Marsh Fork at Maben, WV	11/1977	11/1980	0.1	9.4	317.0
03202900	Guyandotte River near Justice, WV	10/1962	8/1968	24.0	736.4	25,700.0
03203000	Guyandotte River at Man, WV	10/1989	8/1998	2.8	467.7	9,050.0
03202490	Indian Creek at Fanrock, WV	6/1974	10/1981	1.2	58.1	2,670.0
03202480	Brier Creek at Fanrock, WV	7/1969	8/1977	0.1	10.2	505.0
03203670	Whitman Creek at Whitman, WV	4/1969	8/1977	0.0	13.3	380.0
03202915	Guyandotte River below R.D. Bailey Dam	11/1978	8/1993	2.9	795.3	9,820.0
03202750	Clear Fork at Clear Fork, WV	6/1978	8/2000	2.2	189.7	6,380.0
03202400	Guyandotte River near Baileysville, WV	7/1968	8/2000	23.0	412.6	17,900.0
03203600	Guyandotte River at Logan, WV	10/1962	8/2000	34.0	1,150.5	40,800.0
03204500	Mud River near Milton, WV	11/1924	10/1980	0.0	290.6	11,700.0
03204000	Guyandotte River at Branchland, WV	10/1915	8/1995	3.8	41,800.0	41,800.0

Source: USGS Water Resources Division (2003).

3.3 Water Quality

Water quality monitoring data for the Guyandotte River watershed were obtained from various sources, including the EPA's STORET database, WVDEP DWWM and Division of Mining and Reclamation (DMR), and sampling efforts conducted in fall 2003. During the 2003 sampling effort, eleven stations were monitored weekly in the lower Guyandotte watershed (See Figure 3-5 for locations). Samples were analyzed for total aluminum, dissolved aluminum, total iron, dissolved iron, pH, selenium, total suspended solids (TSS), sulfate, acidity and alkalinity. Field parameters that were measured included dissolved oxygen (DO), specific conductance and pH. Stream flow was also measured at five stations (Stations 6,7,8,9, and 11). In addition, as part of the NPDES program, mining companies are required to monitor in-stream water quality upstream and downstream of all discharging outlets. WVDEP requested that mining companies submit these monitoring data in electronic format from areas affected by TMDL development throughout the state. Monitoring data were received from the following ten mining operations in the Guyandotte River watershed:

- Bluestone Coal Corporation
- Consolidation Coal Company
- Eastern Associated Coal Corporation
- Island Creek Coal Company
- Laurel Run Mining Company
- Kepler Processing Company, Inc.
- Riverton Corporation
- Pioneer Fuel Corporation
- Peachtree Ridge Mining Company, Inc.
- Ferrell Excavating Company, Inc.

The data were used to characterize the in-stream water quality conditions. As stated in Section 2, there are 496 water quality monitoring stations in the watershed. Although a large number of stations provided extensive spatial coverage, few stations provided good temporal distribution of water quality data. The water quality monitoring data, along with pertinent source information, are summarized for each of the 14 regions in Appendixes A-1 through A-14 of this report.

3.4 Sources with NPDES Permits

A point source, according to 40 CFR 122.3, is any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, and vessel or other floating craft from which pollutants are or may be discharged. The NPDES Program, established under Clean Water Act sections 318, 402, and 405, requires permits for the discharge of pollutants from point sources. Metals and pH point sources can be classified into two major categories: permitted non-mining point sources and permitted mining point sources. Fecal point sources are classified by several different types of sewage permits.

3.4.1 Permitted Non-mining Sources

Data regarding non-mining point sources were retrieved from EPA's Permit Compliance System (PCS) and WVDEP. Three non-mining point sources in the Guyandotte River watershed are permitted to discharge metals (iron, aluminum, manganese, and/or selenium). These sources are shown in Table 3-3. All discharges are required to discharge within a pH criterion range of 6 to 9 (inclusive). Based on the types of activities and the minimal flow of their discharges, these permitted non-mining sources are believed to be negligible. Under this TMDL, these minor discharges are assumed to operate under their current permit limits. These facilities will be assigned WLAs that allow them to discharge at their current permit limits.

Construction Stormwater permits were not included in the TMDL development process, as limited information was available on these permits in the Guyandotte River watershed. Based on the information that was available, they were considered to be an insignificant source of metals and any effects are accounted for in the in-stream monitoring and margin of safety.

Table 3-3. Non-mining sources in the Guyandotte River watershed

NPDES ID	Facility Name	Facility Type	Status	Issue Date	Expire Date
WV0076899 (now covered under WVG640084)	Town of West Hamlin	Individual Industrial	Active	10/10/2002	8/27/2005
WV0115347 (now covered under WVG 640092)	Mill Creek Wastewater Treatment Plant	Individual Industrial	Active	10/9/2002	8/27/2005
WV0076058	North Springs Branch Landfill	Industrial Solid Waste Landfill	Active	3/10/1998	10/12/2008

Sources: U.S. EPA PCS, WVDEP.

3.4.2 Permitted Mining Sources

Untreated mining-related point source discharges from deep, surface, and other mines typically have low pH values and contain high concentrations of metals (iron, aluminum, and manganese). Mining-related activities are commonly issued NPDES discharge permits that contain effluent limits for total iron, manganese, nonfilterable residue, and pH. Most permits also include effluent monitoring requirements for total aluminum. Since the criteria change from total to dissolved aluminum, all permittees are additionally required to monitor for three years for both total and dissolved aluminum (see Section 1.4). This monitoring will determine whether or not the streams are impaired for dissolved aluminum and also provide data necessary to calculate site-specific translators, as necessary. Division of Mining and Reclamation (DMR) provided a spatial coverage of the mining-related NPDES permit outlets and the related permit limit and discharge data (acquired from West Virginia's ERIS database). The spatial coverage was used to determine the location of the permit outlets, however, additional information was needed to determine the areas of the mining activities. WVDEP DMR also provided a spatial coverage and related SMCRA Article 3 permit information. This information includes both active and inactive mining facilities, which are classified by type of mine and facility status. The mines are classified into eight different categories: coal surface mine, coal underground mine, haul road, coal preparation plant, coal reprocessing, prospective mine, quarry, and other. The haul road and prospective mine categories represent mining access roads and potential coal mining areas, respectively. The permits were also classified into seven categories describing the mining status of each permitted discharge. WVDEP DMR provided a brief description regarding classification and associated potential impact on water quality. Table 3-4 lists the mining types and provides status descriptions.

Table 3-4. Classification of West Virginia mining permit type and status

Type of Mining	Status Code	Description
- Coal surface mine - Coal underground mine - Haul road - Coal preparation plant - Coal reprocessing - Prospective mine - Quarry - Other	Completely Released	Completely reclaimed, revegetated; should not be any associated water quality problems
	Phase II Released	Sediment and ponding are gone, partially revegetated, very little water quality impact
	Phase I Released	Regraded and reseeded: initial phase of the reclamation process; could affect water quality
	Renewed	Active mining facility, assumed to be discharging according to the permit limits
	New	Newly issued permit; could be active or inactive; assumed to be discharging according to permit limits
	Inactive	Currently inactive; could become active anytime; assumed to be discharging according to discharge limits
	Revoked	Bond forfeited; forfeiture might be caused by poor water quality; highest potential for impact on water quality

Source: WVDEP DMR

In order to characterize the mining point sources properly, the type, status, and area of each SMCRA Article 3 permit had be reconciled with the locations each of the mining-related NPDES outlets. WVDEP DMR assisted with the process of associating the SMCRA Article 3 permits with NPDES outlets. The mining point sources were then represented in the TMDL development process and were assigned individual wasteload allocations for metals.

Coal mining operations in West Virginia typically have discharge permits for concentrations of total iron, total manganese, total nonfilterable residue, and pH. Permittees are also required to monitor for total aluminum discharges. Mining permits will be subject to dissolved aluminum monitoring requirements upon permit reissuance, as described in Section 1.4.

Sandstone quarries have permit discharge concentrations for total iron, total manganese, total nonfilterable residue, and pH; limestone quarries, however, do not.

There are a total of 301 mining-related NPDES permits in the Guyandotte River watershed. A complete listing of these permits is provided in Appendix B, and Figure 3-1 illustrates the extent of the mining operations in the Guyandotte River watershed.

The Surface Mining Control and Reclamation Act of 1977 (SMCRA, Public Law 95-87) and its subsequent revisions were enacted to establish a nationwide program to protect the beneficial uses of land or water resources, protect public health and safety from the adverse effects of current surface coal mining operations, and promote the reclamation of mined areas left without adequate reclamation prior to August 3, 1977. SMCRA requires a permit for the development of new, previously mined, or abandoned sites for the purpose of surface mining. Permittees are required to post a performance bond that will be sufficient to ensure the completion of reclamation requirements by regulatory authority in the event that the applicant forfeits. Mines that ceased operating by the effective date of SMCRA, (often called “pre-law” mines) are not subject to the requirements of SMCRA.

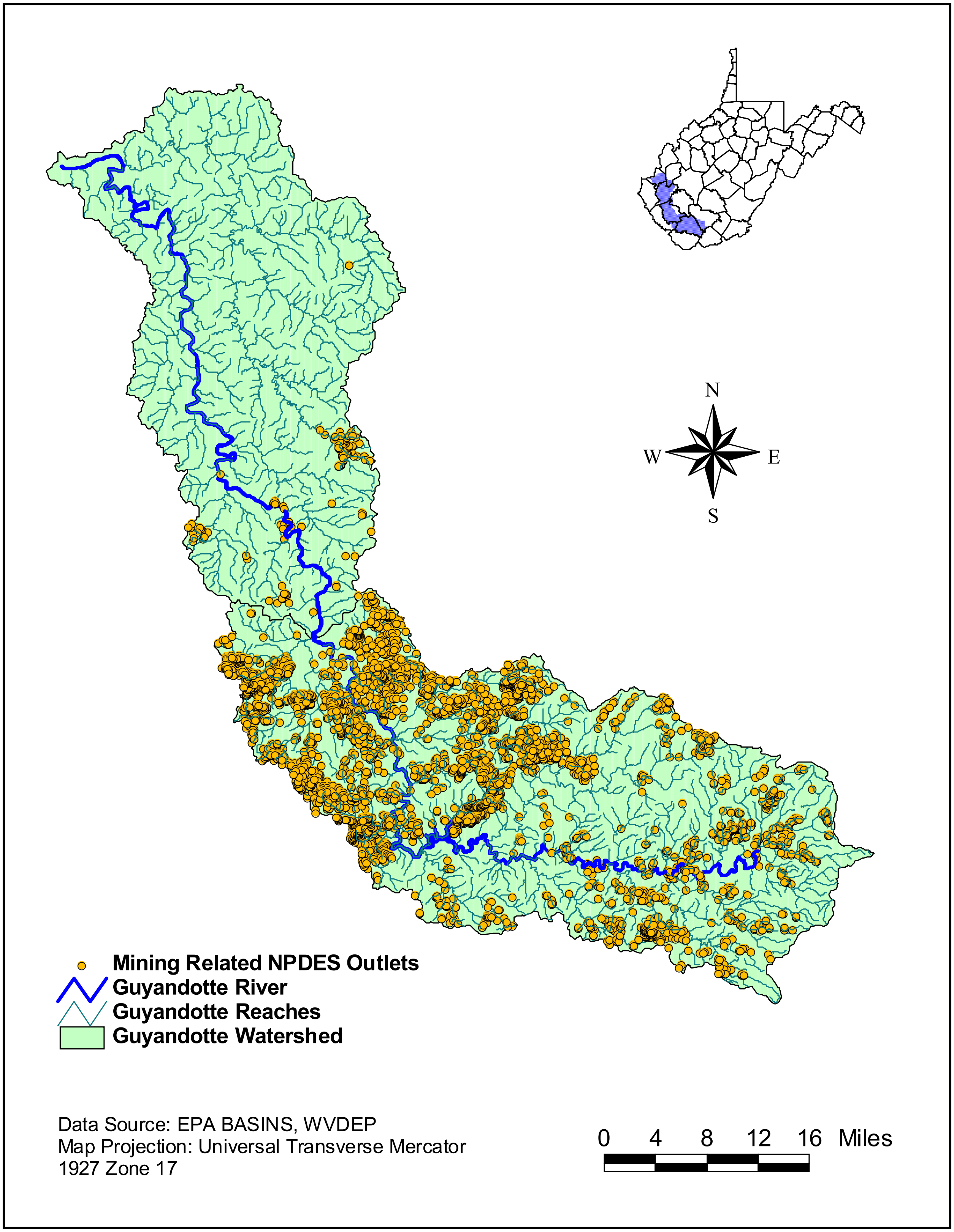

Figure 3-1. Mining permits in the Guyandotte River watershed

Title IV of SMCRA is designed to provide assistance for reclamation and restoration of abandoned mines, while Title V states that any surface coal mining operations must be required to meet all applicable performance standards. Some general performance standards include:

- Restoring the land affected to a condition capable of supporting the uses that it was capable of supporting prior to any mining.
- Backfilling and compacting (to ensure stability or to prevent leaching of toxic materials) to restore the approximate original contour of the land with all highwalls.
- Minimizing the disturbances to the hydrologic balance and to the quality and quantity of water in surface and ground water systems both during and after surface coal mining operations and during reclamation by avoiding acid or other toxic mine drainage.

Before August 3, 1977, mining companies were not responsible for reclaiming and restoring mined areas. Drainage from these unreclaimed areas, or abandoned mine lands, was often left untreated.

For purposes of these TMDLs only, WLAs are given to NPDES-permitted discharge points, and LAs are given to discharges from activities that do not have an associated NPDES permit, such as abandoned mine lands, including but not limited to, tunnel discharges, seeps, and surface runoff. The decision to assign load allocations to abandoned and reclaimed mine lands does not reflect any determination by EPA as to whether there are, in fact, unpermitted point source discharges within these landuses. In addition, by establishing these TMDLs with mine drainage discharges treated as load allocations, EPA is not determining that these discharges are exempt from NPDES permitting requirements.

3.4.3 Permitted Fecal Sources

Point sources that experience effluent overflows or that do not comply with permit limits can cause high loadings of fecal coliform bacteria to receiving streams. The most prevalent fecal coliform point sources are the permitted discharges from sewage treatment plants. Fecal coliform bacteria limits of 200 counts/100 ml (monthly average) and 400 counts/100 ml (daily maximum) are imposed in NPDES permits of all types, and are more stringent than applicable water quality criteria. Appendix C lists the 382 point sources in the Guyandotte River watershed that are potential sources of fecal coliform bacteria. More detailed information on these permits is provided in Appendix C.

The following sections discuss specific types of permitted facilities that are considered fecal point sources in the Guyandotte watershed.

Individual NPDES Permits for Sewage Treatment Facilities

There are 22 sewage treatment facilities covered by Individual NPDES permits in the Guyandotte River watershed including 17 publicly owned treatment works (POTW), three NPDES permits designated as “Individual Other,” and two Individual permits with fecal coliform limits (Appendix C). “Individual Other” are those facilities that are not general facilities greater than 50,000 GPD; WV still has some facilities with multiple outlets classified as Individual Other and they will be covered under separate general permit registrations if they are less than 50,000 GPD.

General Sewage Permits

General sewage permits are designed to cover similar discharges from various individual owners and facilities throughout the state under one umbrella permit. General Permit number WVG550000 covers small, privately-owned sewage treatment plants that have a design flow of less than 50,000 gpd. The general permit contains effluent limits and self monitoring requirements for fecal coliform. There are 138 facilities covered under this permit in the watershed, and they are permitted to direct discharge of treated sewage into waters of the State. See Appendix C.

Combined Sewer Overflows (CSOs)

There are also 10 combined sewer overflows (CSOs) that have been identified in the Guyandotte watershed. The CSOs outfalls are part of the sewer system associated with the City of Logan's sewage treatment plant (STP) (WV0033821). All ten outfalls discharge to the Guyandotte River mainstem. These outfalls do not have permit limits for fecal coliform bacteria, however, they are another potential source of fecal coliform bacteria. Based on limited discharge/overflow information, the fecal coliform contributions from periodic discharges of the CSOs outfalls were captured as a part of the urban land use contributions from the City of Logan.

Home Aeration Units

Approximately 222 homes in the Guyandotte River watershed are not connected to a centralized sewage collection and treatment system and do not have septic systems to treat their waste. Instead, these homes use home aeration units (HAUs). HAUs are most often used where there is limited land area for a leach field, a shallow water table, or slowly permeable soils (WVU, 1995 – 1997). HAUs are permitted under General Permit number WV0107000, which has limits for fecal coliform bacteria of 200 counts/100 ml (average monthly) and 400 counts/100 ml (maximum daily).

A two-year maintenance contract from the HAU distributor is required immediately after installation, however, the homeowner is subsequently responsible for maintaining the system within permit limits. A survey of HAUs was conducted through a cooperative effort between the Division of Plant and Soil Sciences and the Environmental Services and Training Division of the National Research Center for Coal and Energy, six county health departments, and the West Virginia Bureau of Public Health (WVU, 1995-1997). The purpose of the study was to determine whether HAUs were discharging water that met health and environmental standards. The HAUs included in the study were selected for intensive examination by analyzing water samples for five-day biological oxygen demand (BOD_5), total suspended solids (TSS), and fecal coliform bacteria. In addition, approximately 150 units were tested for levels of residual chlorine and turbidity. The results of the study indicated that many HAUs are not functioning as originally intended. Based on permit criteria for BOD_5, TSS, and fecal coliforms, more than 90 percent of the inspected HAUs failed to meet state effluent criteria for at least one of the pollutants (WVU, 1995-1997). The estimated failure rate for the HAUs in the Fourpole Creek watershed in nearby Cabell County was 50 percent (Stan Mills, county sanitarian, 2002, personal communication). Because HAUs are permitted units, any failure is a permit compliance issue; therefore HAUs were modeled without failure, at their permit limits.

3.5 Sources That Do Not Have NPDES Permits

In addition to permitted point sources, there are unpermitted sources and diffuse sources which also contribute to water quality impairments in the Guyandotte River watershed. Nonpoint metals source contributions and contributions from sources without NPDES permits were grouped for assessment into three separate categories: AML, sediment sources, and other nonpoint sources. Other significant unpermitted sources are facilities that were subject to SMCRA but forfeited their bonds or abandoned operations. Nonpoint and nonpermitted fecal coliform sources include urban runoff, agriculture, wastewater disposal via leaking septic systems and illicit discharges of untreated sewage, and natural sources, such as wildlife.

Based on the identification of a number of abandoned mining activities in the Guyandotte River watershed, abandoned mine lands (AML) represent a significant metals and pH source. Abandoned mines contribute acid mine drainage (AMD), which produces low pH and high metals concentrations in surface and subsurface water. AMD occurs when surface and subsurface water percolates through coal-bearing minerals containing high concentrations of pyrite and marcasite, which are crystalline forms of iron sulfide (FeS_2). The chemical reactions of the pyrite generate acidity in water. A synopsis of these reactions is as follows: Exposure of pyrite to air and water causes the pyrite to oxidize. The sulfur component of pyrite is oxidized, releasing dissolved ferrous (Fe^{2+}) ions and also hydrogen (H^+) ions. It is these H^+ ions that cause the acidity. The intermediate reaction with the dissolved Fe^{2+} ions generates a precipitate, ferric hydroxide [$Fe(OH)_3$], and also releases more H^+ ions, thereby causing more acidity. A third reaction occurs between the pyrite and the generated ferric (Fe^{3+}) ions, in which more acidity (H^+) is released as well as Fe^{2+} ions, which can then enter the reaction cycle (Stumm and Morgan, 1996).

Nonpoint source contributions and contributions from sources without NPDES permits were grouped for assessment into three separate categories: AML, sediment sources, and other nonpoint sources. Figure 3-2 is a schematic of potential sources in the Guyandotte River watershed. The landuse distribution for the Guyandotte River watershed is shown in Figure 3-3.

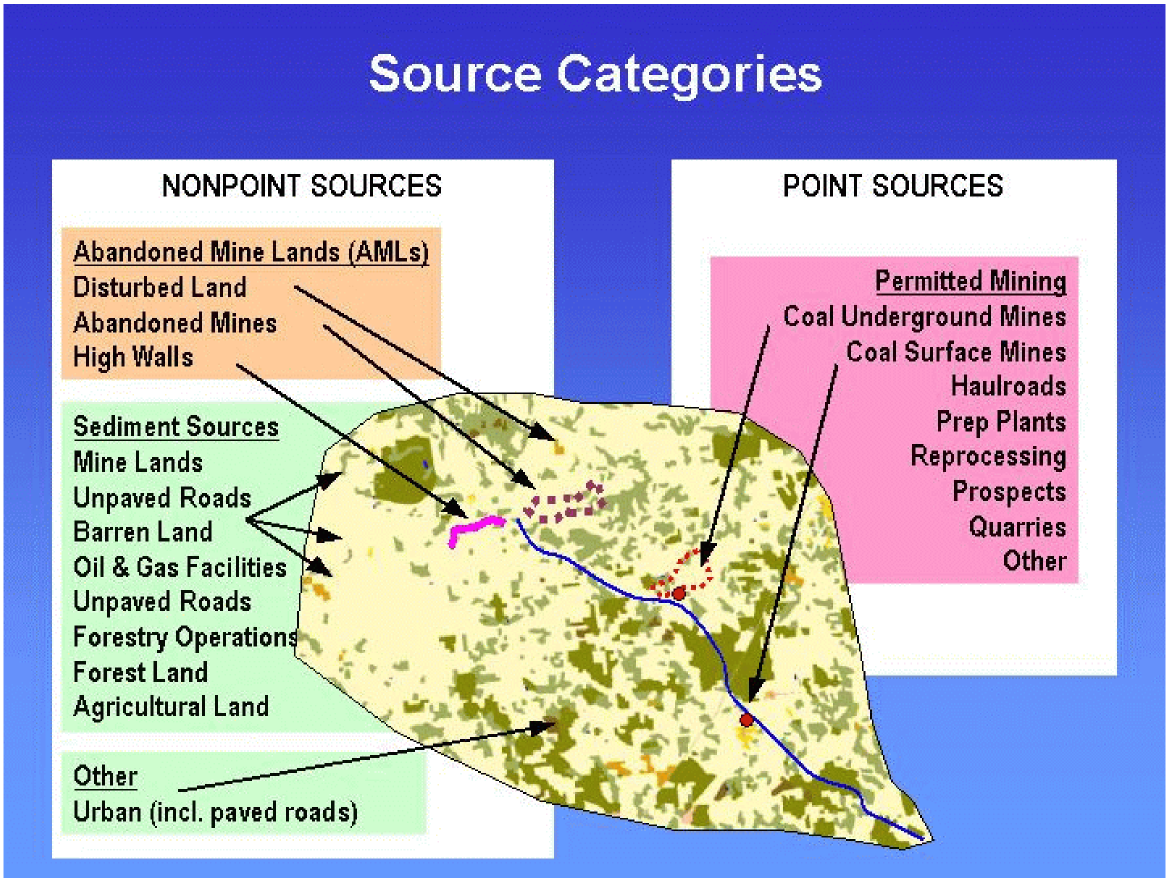

Figure 3-2. Potential sources contributing to impairments in the Guyandotte River watershed

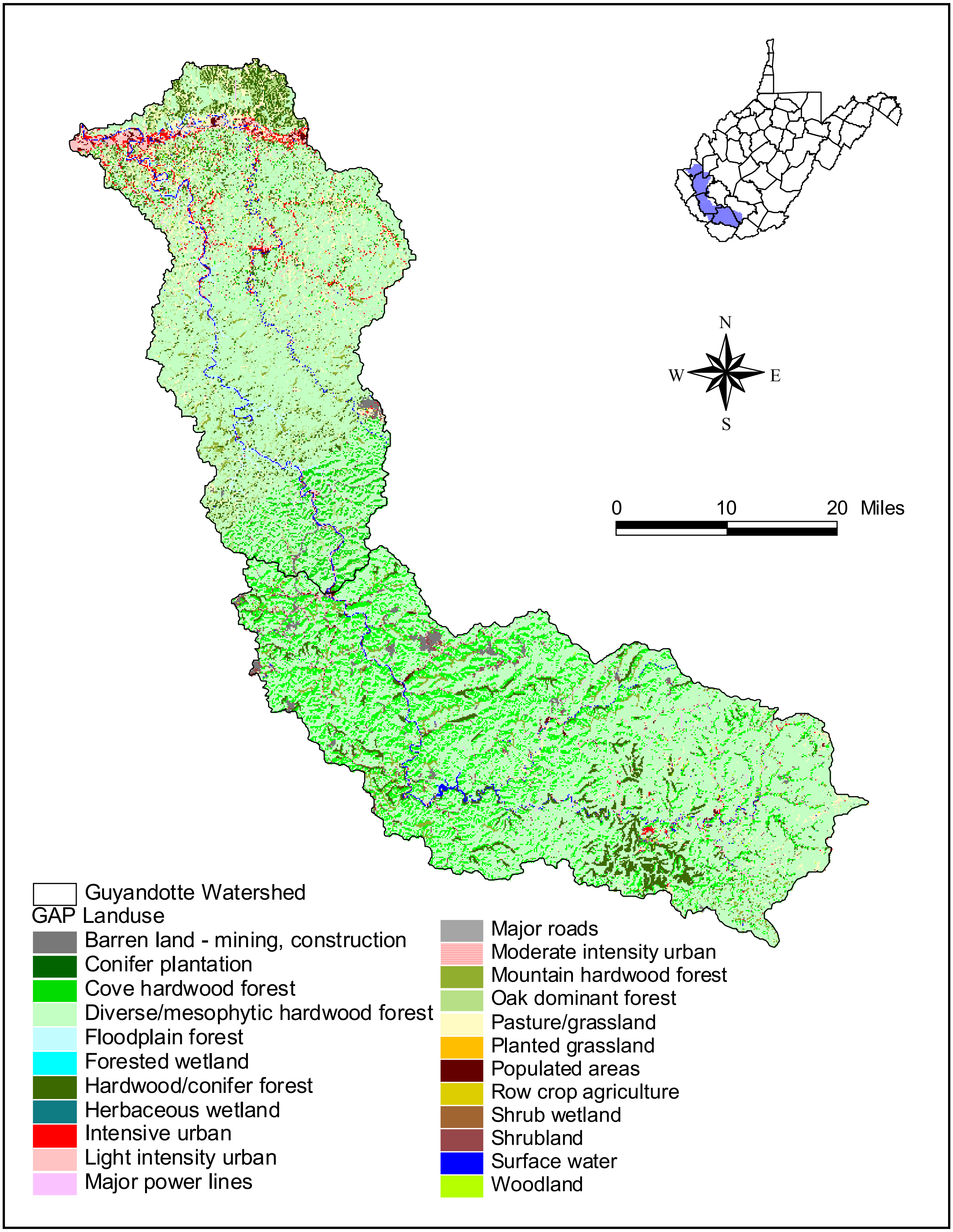

Figure 3-3. Landuse coverage in the Guyandotte River watershed

3.5.1 Abandoned Mine Lands (AML) and Revoked Mines

Generally, the numerous abandoned surface and deep mines are responsible for the AMD flows (WVDEP, 1985). Data regarding AML sites in the Guyandotte River watershed were compiled from spatial coverages provided by WVDEP DMR. The AML sites were classified into three categories:

- *High walls*: generally vertical face of exposed overburden and coal from surface and underground mining activities.
- *Disturbed land*: disturbed land from both surface and underground mining activities.
- *Abandoned mines*: abandoned surface and underground mines.

Additional qualitative data were retrieved from WVDEP DMR Problem Area Data Sheets (PADSs). Information regarding the locations of the largest sources, abandoned mines, is presented in Table 2 in each of Appendixes A-1 through A-14.

Mines with revoked permits no longer have permittees responsible for treating the discharges from the mines. The WVDEP Special Reclamation Program uses forfeited bonds and special coal taxes to achieve the reclamation required by the original permit. In the absence of an NPDES permit, the discharges associated with these landuses were assigned load allocations, as opposed to wasteload allocations. The decision to assign load allocations to abandoned mine lands does not reflect any determination by EPA as to whether there are, in fact, unpermitted point source discharges within these landuses. In addition, by establishing these TMDLs with mine drainage discharges treated as load allocations, EPA is not determining that these discharges are exempt from NPDES permitting requirements.

3.5.2 Sediment Sources

In the Guyandotte River watershed, land-based nonpoint and/or unpermitted sources of sediment include abandoned and active mine areas, forestry operations, oil and gas operations, unpaved roads, agricultural landuses, barren land, and mature forestland. High-sediment-yield areas include disturbed lands such as unpaved roads, forest harvest areas and access roads, oil and gas operations, agricultural land, barren land, and active mine areas, and represent approximately 3 percent of the watershed area. Mature forestland and other undisturbed areas have the lowest sediment yield and therefore the lowest impact on receiving waters. A conceptual representation of sediment loading from nonpoint sources relative to the natural or undisturbed forest condition is presented in Table 3-5. To represent land-based nonpoint sources in the Guyandotte River watershed spatially, the GAP 2000 landuse coverage for each subwatershed was updated to include paved and unpaved road areas, forest harvest areas, oil and gas operations, and mining areas.

Table 3-5. Sediment source characterization

	Sediment Contribution			Time Scale of Impact on Receiving Waterbody	
Sources	**High**	**Medium**	**Low**	**Long**	**Short**
Forest (undisturbed)[a]			X	NA[b]	NA[b]
Forest operations	X				X
Access roads in forest	X			X	
Agriculture		X		X	
Oil and gas drilling		X			X
Oil and gas access road	X			X	
Mining (abandoned)		X		X	
Mining (active)			X	X	
Construction	X				X
Roadway construction	X				X
Paved roads and highways			X	X	
Unpaved roads	X			X	
Point sources (permitted)			X	X	

[a] - Undisturbed forest condition is the reference-level condition.
[b] - NA = Not applicable.

Based on the data analysis and source characterization, AML was identified as a critical and controllable source, especially in the Upper Guyandotte River watershed. Other potential sediment sources were assessed and major contributing landuses either were not present or were not of significant size. High-sediment-yield areas include disturbed lands such as unpaved roads, forest harvest areas and access roads, oil and gas operations, crop land, barren land, and active mine areas. These landuses represent a small portion of the total watershed area. As discussed in Section 3.4.1, Construction Stormwater permits were considered as an insignificant source of metals and/or sediment and any effects were accounted for in the in-stream monitoring and margin of safety.

Additional data analysis was conducted to support source characterization. Appendix D shows the data used to evaluate the relationship between loading sources and in-stream water quality targets for aluminum, iron, and manganese. The analysis was conducted for the Guyandotte River (USGS gauging station 550639) at Huntington, West Virginia, during the period from 1990 to 1995. Other analyses were conducted by comparing aluminum and iron concentrations with total suspended solids (TSS). Data collected at sampling stations along the main stems of the Guyandotte River, Mud River, and Pinnacle Creek from 2000 to 2003 were also used.

The relationships between flow and total aluminum, iron, and manganese concentrations were examined using data collected at Guyandotte River sampling station 550639. The data analyzed at station 550639 consisted of 53 observations for each of the three metals. Figures 1, 2 and 3 in Appendix D demonstrate the relationships between flow and iron, aluminum, and manganese. The data shows that elevated metals concentrations are more likely to occur during flow events at or above the 50^{th} percentile. Figures 4, 5 and 6 in Appendix D indicate a weak relationship between flow and total metal concentrations (iron, 0.2643; aluminum, 0.2791; manganese, 0.1417).

Additional data analysis was conducted on data compiled from the main stem of the Guyandotte River (80 observations), Mud River (55 observations), and Pinnacle Creek (14 observations). The correlation coefficients indicate a positive relationship between increasing TSS and increasing iron concentrations (Appendix D, Figures 7, 8, and 9).

Aluminum concentrations were analyzed from the same data set that was used above. The data from the main stem of the Guyandotte River exhibited a correlation coefficient of 0.8636 (Appendix D, Figure 10), however only very weak relationships between TSS and total aluminum concentrations were seen in the main stem of the Mud River and Pinnacle Creek (Appendix D, Figures 11 and 12).

3.5.3 Other Metals Sources That Do Not Have NPDES Permits

The predominant landuses in the Guyandotte River watershed were identified based on the USGS's GAP 2000 landuse data (representative of the mid-1990s). According to the GAP 2000 data, the major landuses in the watershed are diverse, mesophytic hardwood forest, which constitutes approximately 62 percent of the watershed area, and cove hardwood forest, which makes up 13 percent of the watershed area. In addition to forestland and pasture/grass landuses, other landuses that might contribute nonpoint source metals loads to the receiving streams include barren and urban land. The landuse distribution for the Guyandotte River watershed is presented in Figure 3-3 and Table 3-6.

Table 3-6. GAP 2000 landuse distribution in the Guyandotte River watershed

GAP 2000 Landuse Category	Area (Acres)	Area (Percent)
Diverse/Mesophytic Hardwood	673,573	62.6
Cove Hardwood Forest	140,029	13
Oak Dominant Forest	58,620	5.4
Pasture/Grassland	56,970	5.3
Mountain Hardwood Forest	33,266	3.1
Hardwood/Conifer Forest	29,530	2.7
Light Intensity Urban	15,595	1.4
Barren Land	15,318	1.4
Floodplain Forest	10,957	1
Surface Water	9,876	0.9
Shrubland	8,144	0.8
Moderate Intensity Urban	7,765	0.7
Major Power Lines	4,697	0.4
Populated Areas	4,441	0.4
Intensive Urban	2,382	0.2
Woodland	2,025	0.2
Row Crop Agriculture	1,211	0.1
Conifer Plantation	418	< 0.1
Herbaceous Wetland	355	< 0.1
Major Roads	326	< 0.1
Forested Wetland	85	< 0.1
Shrub Wetland	75	< 0.1
Planted Grassland	33	< 0.1

3.5.4 Selenium Source Characterization

As shown previously in Table 1-5, there are four waterbodies listed on West Virginia's 2002 Section 303(d) list for not meeting water quality criteria for selenium: Mud River, Sugartree Branch, Stanley Fork, and Hall Fork/Left Fork of Cow Creek. These impaired waterbodies are shown in Figure 3-4.

These streams were listed based on data collected by EPA (from August 2000 through February 2001) during investigations for the Mountaintop Removal Environmental Impact Study (USEPA, 2002). As shown in Table 3-7a, all 24 observations on these four streams violated the chronic aquatic life criterion for total selenium (5.0 ug/L), 7 observations violated the acute aquatic life criterion (20.0 ug/L), and 14 observations violated the Human Health not-to-exceed criterion of 10 ug/L.

Table 3-7a. Water quality observations for selenium in the Guyandotte River watershed collected for the Mountaintop Removal Environmental Impact Study

Stream Name	DNR Code	Total Observations	Total Selenium (ug/L)			Water Quality Criteria Violations		
			Ave	Min	Max	5 ug/L	20 ug/L	10 ug/L
Sugar Tree Branch	WVOGM-48	6	36.8	28.3	49.3	6	6	6
Stanley Fork	WVOGM-47	6	10.7	7.2	14.9	6	0	3
Mud River	WVOG-2	6	12.3	5.1	24.8	6	1	4
Hall Fork/Left Fork Cow Creek	WVOG-65-J-3-A	6	8.7	5.6	10.4	6	0	1

Source: WVDEP, EPA

In order to further characterize potential selenium sources in these streams, it was necessary to conduct additional monitoring. EPA collected weekly samples at 11 strategic locations in the Guyandotte watershed from September 2, 2003 through October 21, 2003. The monitoring locations shown in Figure 3-5 were selected to evaluate the spatial distribution of total selenium concentrations in the Guyandotte watershed. The sampling effort also attempted to capture temporal changes from both summer baseflow and episodic runoff events to further examine how in-stream concentrations of total selenium vary with flow. Results of the recent monitoring data summarized in Table 3-7b shows that detectible amounts of selenium are only present in isolated upstream reaches of the Mud River (Stations 6 through 9) in the Guyandotte watershed. Ten samples collected on Hall Fork/Left Fork/Cow Creek all had results below both detection limits and water quality criteria. Therefore, Hall Fork/Left Fork/Cow Creek does not need a TMDL for selenium. West Virginia has delisted Hall Fork/Left Fork/Cow Creek from its Draft 2004 Section 303(d) list based on the recent data and West Virginia's listing methodology.

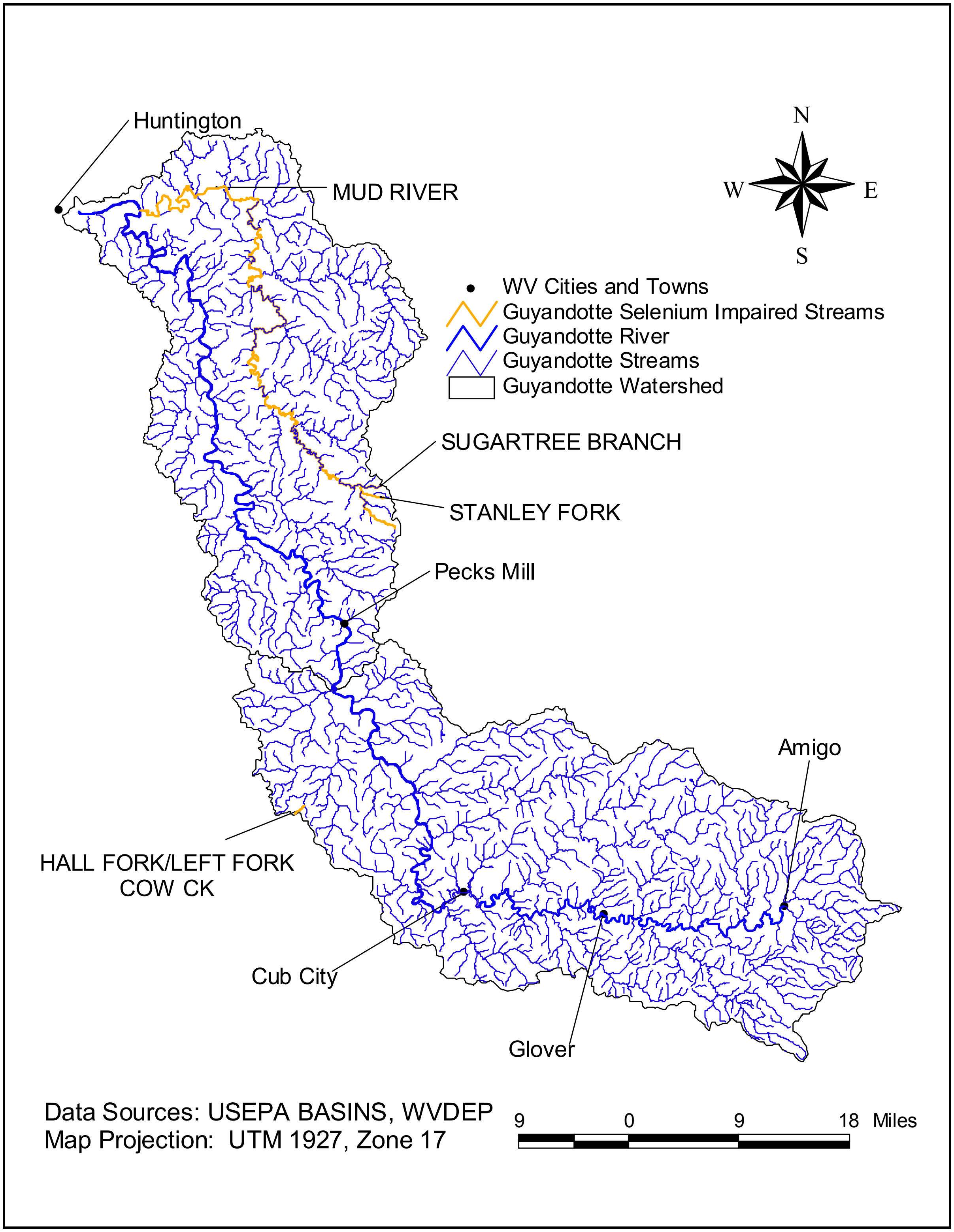

Figure 3-4. Selenium impaired waterbodies in the Guyandotte watershed

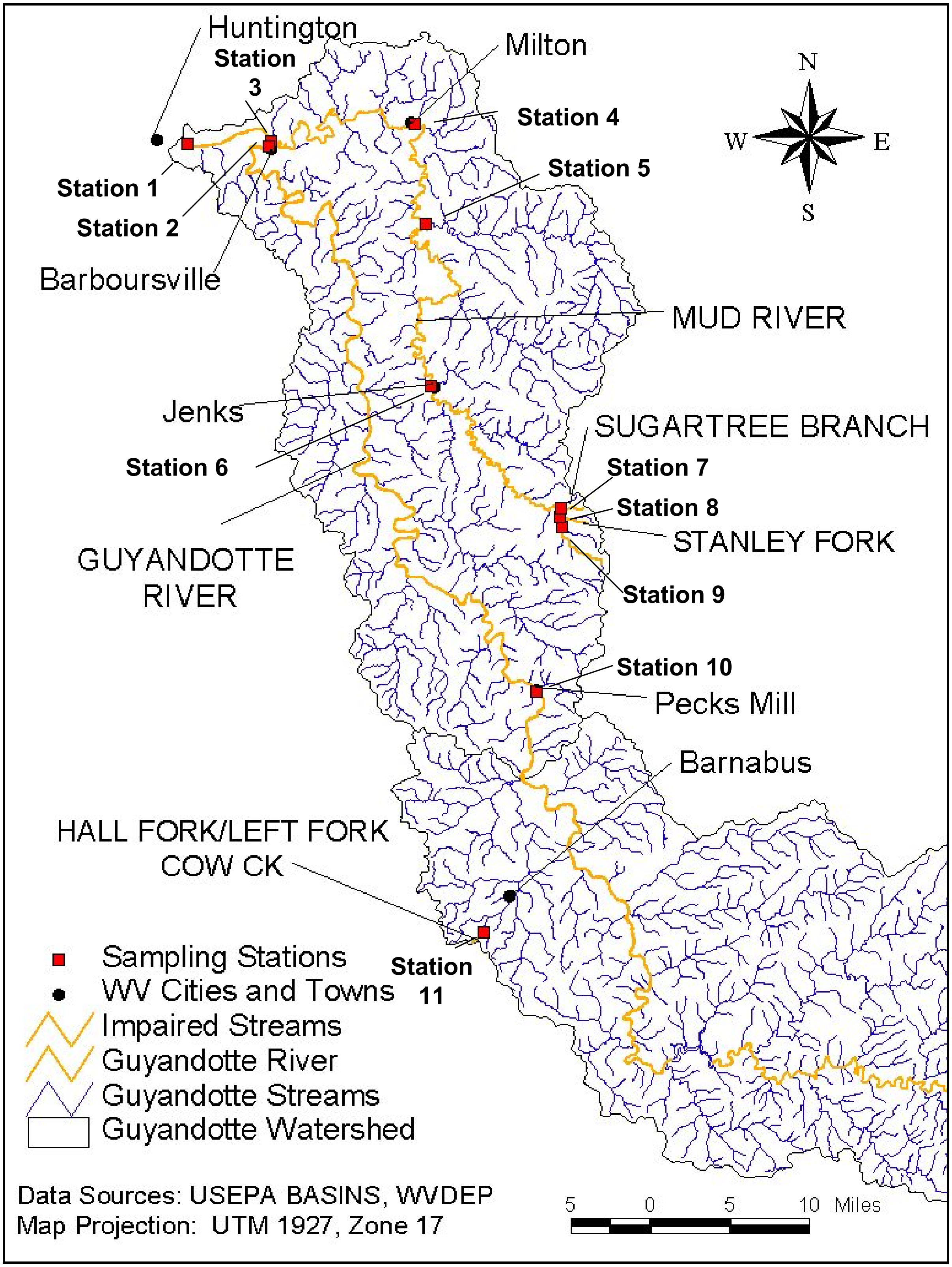

Figure 3-5. Selenium sampling locations in the Guyandotte River watershed

Table 3-7b. Summary of recently collected selenium water quality data from Fall 2003

Station ID	Stream Name	DNR Code	Total Samples	Total Selenium (ug/L)			Total Below Detection Limit (3 ug/L)	Water Quality Criteria Violations		
				Ave	Min	Max		5 ug/L	20 ug/L	10 ug/L
1	Guyandotte River	WVO-4	10	-	-	-	10	0	0	0
2	Guyandotte River	WVO-4	10	-	-	-	10	0	0	0
3	Mud River	WVOG-2	10	-	-	-	10	0	0	0
4	Mud River	WVOG-2	10	-	-	-	10	0	0	0
5	Mud River	WVOG-2	10	-	-	-	10	0	0	0
6	Mud River	WVOG-2	10	3.25	2.85	4.00	4	0	0	0
7	Sugar Tree Branch	WVOGM-47	10	15.71	10.3	19.60	0	10	0	10
8	Stanley Fork	WVOGM-48	10	6.66	5.4	8.00	0	10	0	0
9	Mud River	WVOG-2	10	4.58	2.94	9.40	4	3	0	0
10	Guyandotte River	WVO-4	10	-	-	-	10	0	0	0
11	Hall Fork/Left Fork/Cow Creek	WVOG-65-J-3-A	10	-	-	-	10	0	0	0

Selenium Sources

Selenium is a naturally occurring element that is found in Cretaceous marine sedimentary rocks, coal and other fossil fuel deposits (Dreher, 1992; CCREM 1987; US-EPA 1987; Haygarth 1994). When such deposits are mined, mobilization of selenium is typically enhanced from crushing of ore and waste materials along with the resulting increase in surface area of material exposed to weathering processes. Studies have shown that selenium mobilization appears to be associated with various surface disturbance activities associated with surface coal mining in Wyoming and western Canada (Dreher and Finkelman 1992; McDonald and Strosher 1998). In West Virginia, coals that contain the highest selenium concentrations are found in a region of south central West Virginia where the Allegheny and upper Kanawha Formations of the Middle Pennsylvanian are mined (WVGES 2002). In fact, some of the highest selenium concentrations (16 to 20 ppm) were found in the vicinity of the upper portion of the Mud River watershed near the Lincoln/Logan county line (Figure 3-6).

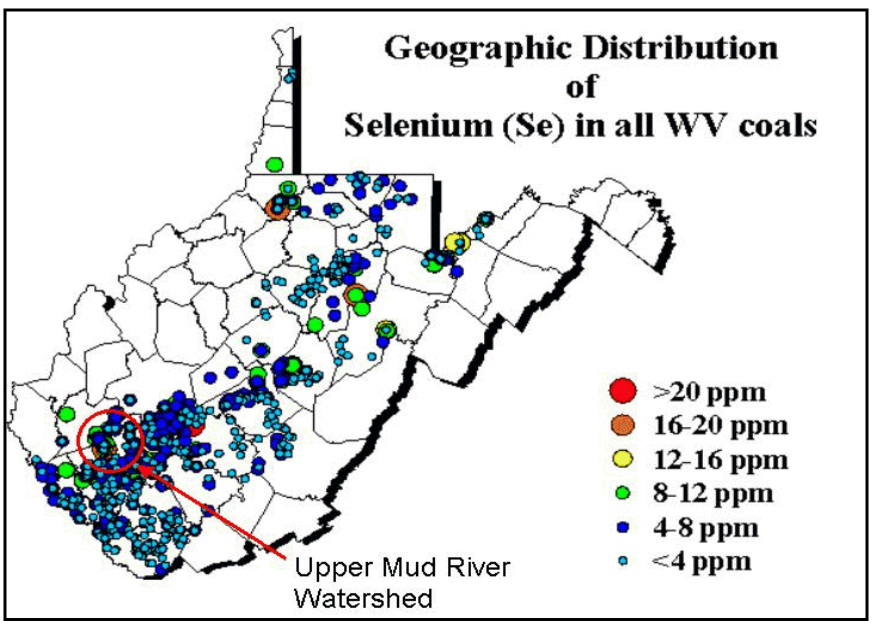

Figure 3-6. Geographic distribution of selenium in WV coals (WVGES)

Mining in the Upper Mud River watershed

WVDEPs mining related GIS coverages were used to identify the location and extent of mining operations in the upper portion of the Mud River watershed. Figure 3-7 illustrates that extensive surface mining operations are present in the upper portion of the Mud River watershed and the presence of valley fills indicate that these mines are mountaintop removal operations. Furthermore, examining the Digital Orthophoto Quadrangles (DOQs) shows nearly all of the Sugartree Branch and Stanley Fork watersheds under various phases of mining and reclamation activities (Figure 3-8)

The four mining related NPDES permits that discharge into the upper portion of the Mud River watershed are issued to a single permittee, Hobet Mining, Inc. Table 3-8 summarizes the NPDES permit information.

Table 3-8. Mining related NPDES permits discharging in the upper portion of the Mud River watershed

PERMIT ID	Responsible Party	Number of. Outlets	NPDES Permit Status Flag	SMCRA Article 3 Permit ID	Mining Type	Article 3 Permit Status	Article 3 Permit Status Code
WV0099392	Hobet Mining, Inc	17	Open	S501692	Surface	Open	Renewed
WV1016695	Hobet Mining, Inc	3	Open	S502295	Surface	Open	New
WV1016776	Hobet Mining, Inc	7	Open	S500396	Surface	Open	Renewed
WV1017225	Hobet Mining, Inc	4	Open	U500798	Underground	Open	New

Summary

Recent water quality monitoring in the Lower Guyandotte watershed indicated that elevated in-stream selenium concentrations were isolated in the upper portion of the Mud River watershed. Given the high selenium content of coals in the upper Kanawha Formation, surface disturbances associated with the extensive surface mining operations is the likely cause of the selenium impairments in Sugartree Branch, Stanley Fork, and the upper portion of the Mud River.

3.5.5 Sources of Fecal Coliform Bacteria That Do Not Have NPDES Permits

Stormwater runoff represents a major nonpoint source of bacteria in both urban and rural areas. Runoff from urban watersheds can be a significant source, delivering bacteria present in litter and in the waste of domestic pets and wildlife to the waterbody. Rural stormwater runoff can transport significant loads of bacteria from livestock pastures, livestock and poultry feeding facilities, and manure storage and application. Natural background sources such as wildlife can also contribute bacteria loadings and may be particularly important in forested or less-developed areas of the watershed. Additional sources of bacteria include on-site wastewater systems (septic tanks, cesspools) that are poorly installed, faulty, or improperly located, and illicit discharges of residential and industrial wastes.

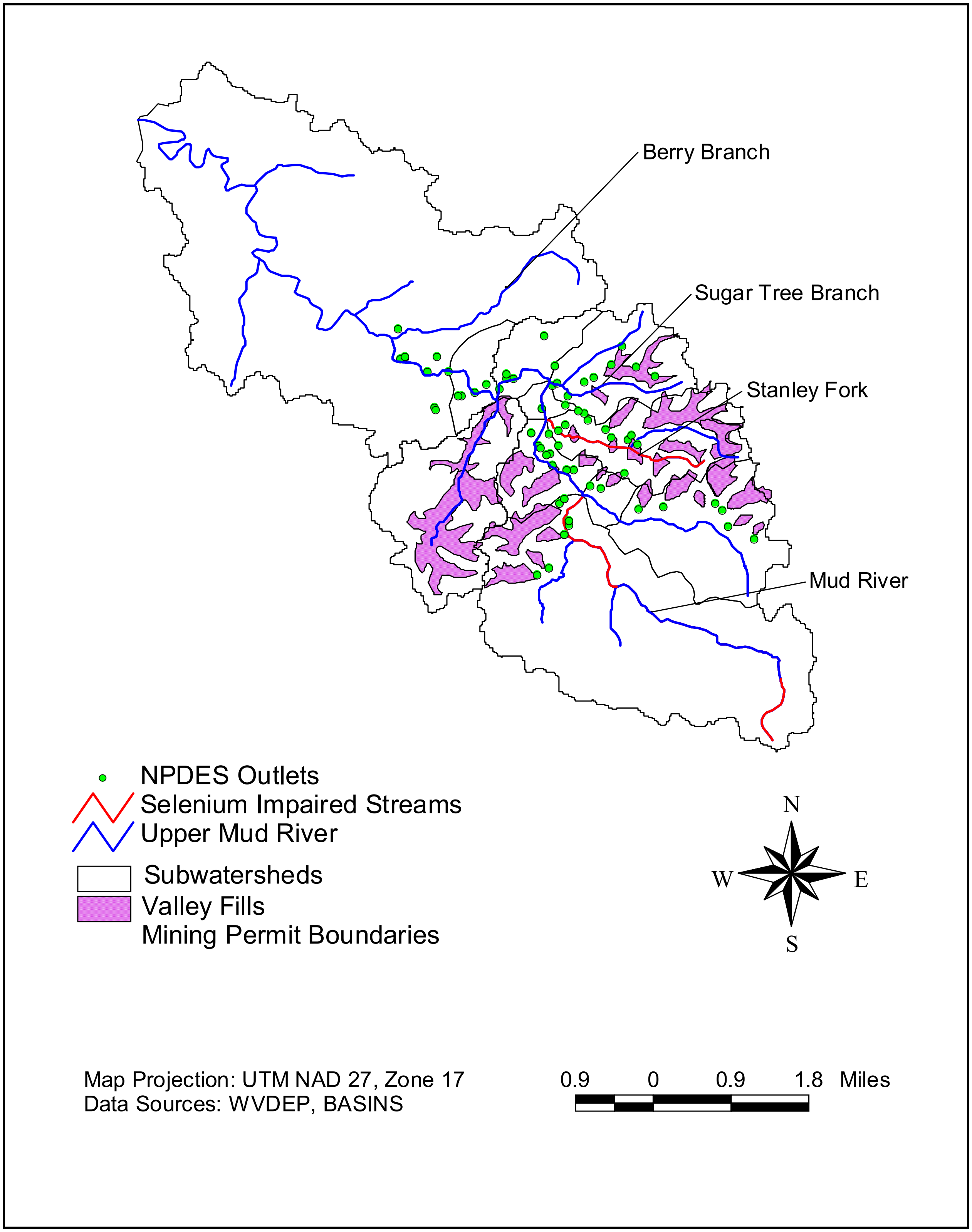

Figure 3-7. Surface mining in the upper portion of the Mud River watershed

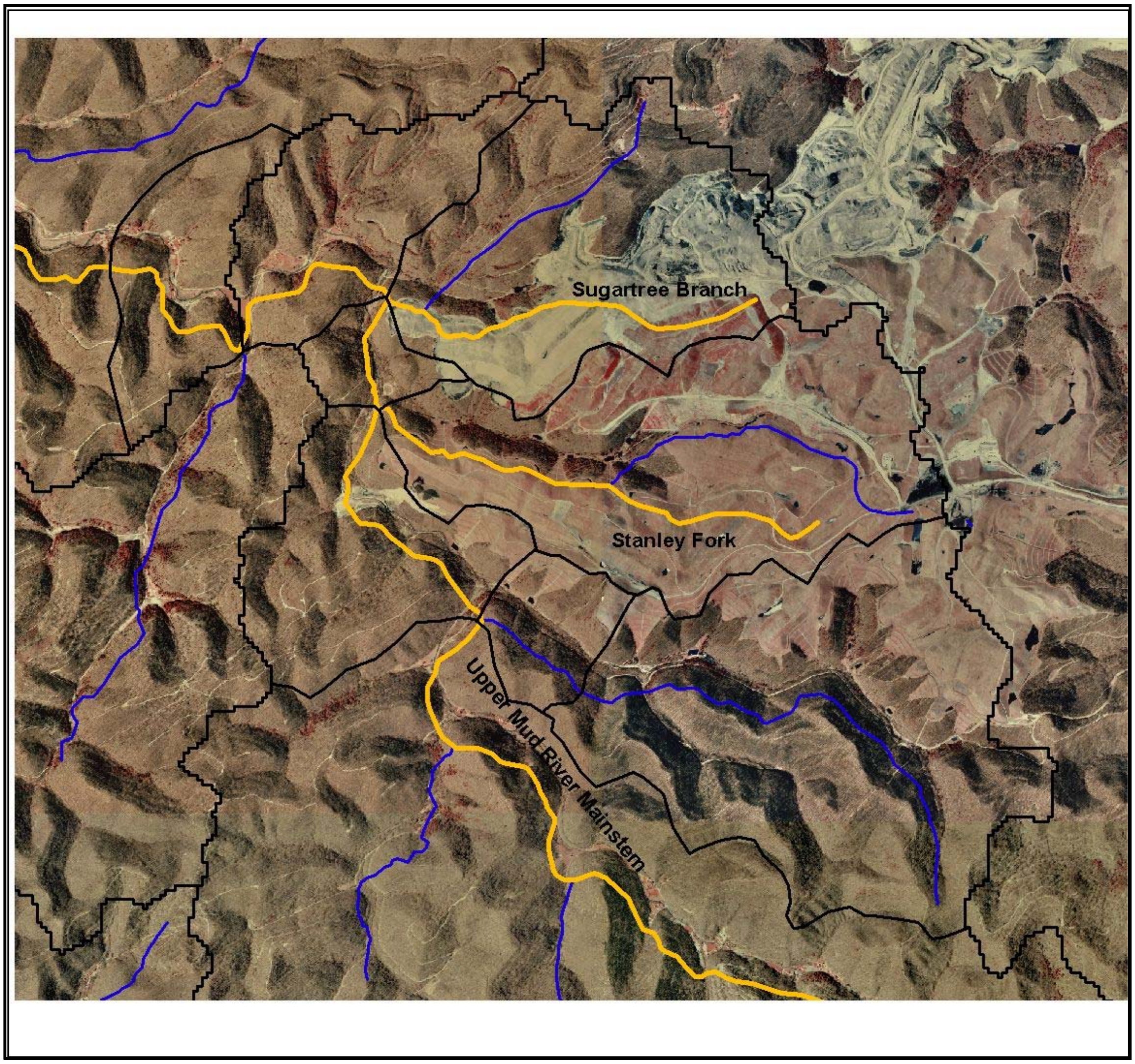

Figure 3-8. Digital Orthophoto Quadrangle of the upper portion of the Mud River watershed

The landuse distribution of the Guyandotte River watershed provides insight into determining nonpoint sources of fecal coliform bacteria. The dominant landuse in the Guyandotte watershed, based on GAP data analysis, is forest (94 percent). Urban areas constitute approximately three percent of the watershed (Table 3-6). Figure 3-3 displays the landuse distribution for the watershed. Other key sources of fecal coliform bacteria identified in the watershed include urban areas, failing septic systems and straight pipes, and natural sources.

Wastewater Disposal

Failing septic systems and straight pipes can contribute fecal coliform bacteria to receiving waterbodies through surface or subsurface malfunctions, and may be the most significant source of fecal coliform bacteria in the Guyandotte River watershed. According to Dave Thorton of the WV Department of Health, the failure rate for septic systems in the nearby Upper Kanawha watershed is estimated to be 70 percent during the first ten years after installation. Census data was used to estimate the number of unsewered homes in the impaired segments of the

Guyandotte River watershed. The TMDL assigns LAs (as opposed to WLAs) to failing septic systems and straight pipes because there are no NPDES Permits associated with them, and because of the type of data available. While we are able to estimate the collective loading contribution of failing septic systems and straight pipes, there is no information as to their individual surface flow contributions and subsurface flow contributions. The fact that these sources receive a load allocation rather than a wasteload allocation does not reflect any determination by EPA as to whether there are, in fact, unpermitted point source discharges. In addition, by assigning a load allocation to these sources, EPA is not determining that these discharges are exempt from NPDES permitting requirements. Generally, EPA considers any straight pipe discharging raw sewage or other pollutants to surface waters as a "point source" for purposes of the CWA (requiring an NPDES permit for authorization to discharge pollutants).

Urban Runoff

Sources of fecal coliform bacteria in urban areas include wildlife and pets, particularly dogs. Much of the loading from urban areas is due simply to the resulting runoff from impervious surfaces during precipitation events. In estimating the potential loading of fecal coliform bacteria from urban areas, accumulation rates are often used to represent the aggregate of available sources. Urban areas, as defined by the GAP landuse, of the Guyandotte River watershed are concentrated around Huntington.

Agriculture

Several agricultural activities or sources related to livestock can contribute fecal coliform bacteria to receiving streams through surface runoff or direct deposition. Grazing livestock and land application of manure result in the deposition and accumulation of bacteria on land surfaces where it is available for washoff and transport during rain events. Additionally, livestock with access to streams can represent a significant source of bacteria, depositing fecal coliform directly to the stream.

Based on GAP 2000 landuse data, it was determined that the impaired portions of the Guyandotte River watershed do not lie in agricultural areas. Although it is assumed that agriculture is not a widespread source of fecal coliform bacteria in the watershed, there may be isolated instances of pastures and feed lots located near impaired segments which may have significant localized impacts on instream bacteria levels.

Natural Sources

Fecal coliform bacteria also originate from natural background sources, primarily in forested areas. Generally, sources include wild animals such as deer, racoons, wild turkeys and waterfowl. Waterfowl may be a significant source in areas of open waters (e.g., flood control basins). The WV Department of Natural Resources estimated a density of 20 deer per acre for the nearby Upper Kanawha watershed, which was also used for the Guyandotte River watershed. Population estimates for other wildlife species were not available. Wildlife is considered a contributing source of fecal coliform bacteria, but not a major source.